Project Title

Scale-Up and Demonstration of Fly Ash Ozonation Technology

Third Quarterly Technical Report
Reporting Period: October - December 2004

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DISCLAIMER

This technical report was prepared with the support of the U.S. Department of Energy, under Award No. DE-FC26-03NT41730. However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of the DOE.

ABSTRACT

This is the third quarterly report under DOE Cooperative Agreement No.: DE-FC26-03NT41730. Due a number of circumstances, mostly associated with subcontractor agreements, the actual beginning of the project was delayed from its original award date of March 5, 2003. DOE's Project Manager was kept informed (verbally) by PPL's Project Manager throughout this period.

Because of this delay, this is the third quarterly report and it refers to the time period from October to December 2004. As the project is in its "pre-deployment" stage, no results are available. This report summarizes the ongoing activities and provides an updated schedule.

No significant issues or concerns are identified.

TABLE OF CONTENTS

LIST OF GRAPHICAL MATERIALS

INTRODUCTION

Objectives

PPL has lost concrete marketability for much of its ash from the Montour power station due to high carbon content. The objective of the project is to demonstrate ash ozonation technology on a utility site, with minimum modification to existing plant equipment and operations and to confirm the process effectiveness through a complete battery of technology performance and concrete quality tests, to develop a plan for effective implementation at the PPL Montour station and for technology transfer to other U.S. coal-fired plants.

EXECUTIVE SUMMARY

Scope of Work

Based on the results of pilot testing performed during the Spring/Summer of 2002 at the Fuller Bulk Handling (FBH) test facility, the project team determined that air merge blending is the technology of choice for fluidization/ozonation of fly ash. In Task 1 of the project, the technology will be deployed and tested at PPL's Montour Steam Electric Station, where it will be integrated with existing ash handling systems. In Task 2 technical and economic analyses will be conducted for a full-scale, commercial design of the technology. Task 3 is proposed as a "documentation" task and will produce a Final Report to DOE. These tasks are described below in more detail.

In this project, PPL will supply a continuous stream of the high-carbon problem ash, as well as ash handling equipment at the station (e.g. silos, fans, etc.). . Ash from other (non-Montour) sources will also be obtained and tested to evaluate the influence of different ash parameters on the effectiveness of the ozonation technology. PCI will supply a new SMA50 ozone generator capable of treating large quantities of ash.. A matrix of contacting conditions and carbon/ozone stoichiometries will be tested and the results compared. Concrete testing of treated ash samples will be performed by CPM and supporting analyses of the ash will be carried out at the Brown University research laboratories. A plan will be developed for implementation of the optimal process at Montour and for technology transfer to other U.S. generating plants. Finally, design guidelines will be developed to allow for an effective "jump" into commercial development.

EXPERIMENTAL

Tasks Description

The proposed scope of work will be broken down into the following major tasks:

TASK 1 – Design/Deploy/Test semi-commercial fluid bed system at Montour Station

Objective – Conduct semi-commercial scale test of fluidization/ozonation of fly ash at PPL's Montour Station using FBH's Airmerge™ blender and PCI's ozonation technologies. Building upon previous tests and development by the project team, FBH will design and fabricate a 42" diameter Airmerge™ batch blender for gas/solids contacting. PCI-Wedeco will supply a new SMA50 ozone generator capable of producing 100 lb/day of ozone operating on air. The system will be integrated with existing ash handling systems at Fly Ash Storage Silo #1 at PPL's Montour Station, as illustrated in Figure 1. Off-gases will be pre-filtered and sent to an ozone destruct unit prior to discharge to atmosphere. FBH will complete the installation approximately 5 months from the start of the project.

Six fly ashes of varying characteristics will be tested in the system to develop a range of system operating parameters. The installed system will accept ash from the silo, "ozonate" the ash in batches, and loadout the ash to PD rail cars through an existing airslide. This streamlined material flow will allow for ash throughput of about 10 tons/day. Testing is anticipated to last approximately five weeks.

The following activities, or subtasks, will be conducted in this task.

- Design and fabricate 42-inch Airmerge™ blender and SMA50 ozone generator.
- Prepare test matrix.

- Deploy fluidization/ozone generator system.
- Interface with Montour ash handling systems (storage silos, dry ash loadout, etc.)
- Conduct parametric tests
    - Operating parameters
        - *fluidization/aeration velocities*
        - *vibratory fluidization enhancement*
        - *raw ash quality (different sources and carbon content)*
        - *ozone reaction stoichiometry (gm-ozone/kg-ash)*
- Conduct ash and concrete analyses (foam index, mortar air-entraining tests, petrography, trial batches for short and extended mixing times)
- Results documentation
- Reporting to DOE

TASK 2 – Design Full Scale-up for Montour Station and Development of Generic Design Guidelines

Objective – Develop design modifications for the full scale-up of the ash fluidization/ozonation system based on overall performance considerations from Task 1. This will serve to demonstrate low-cost retrofit potential to existing systems at normal operating conditions. Develop generic design guidelines addressing technical and cost considerations, for commercializing the technology. The following activities, or subtasks, will be conducted in this task.

- Design modifications for existing systems
- Develop design guidelines for wide-applicability ozonation systems
- Cost/Economic analyses
- Results documentation
- Reporting to DOE

TASK 3 – Final Report

Objective – Provide full documentation of project results and develop design guidelines, cost estimates commercialization potential for the technology. This will include:

- Design criteria
- Performance expectations
- Cost
- Applicability
- Deployment and operation

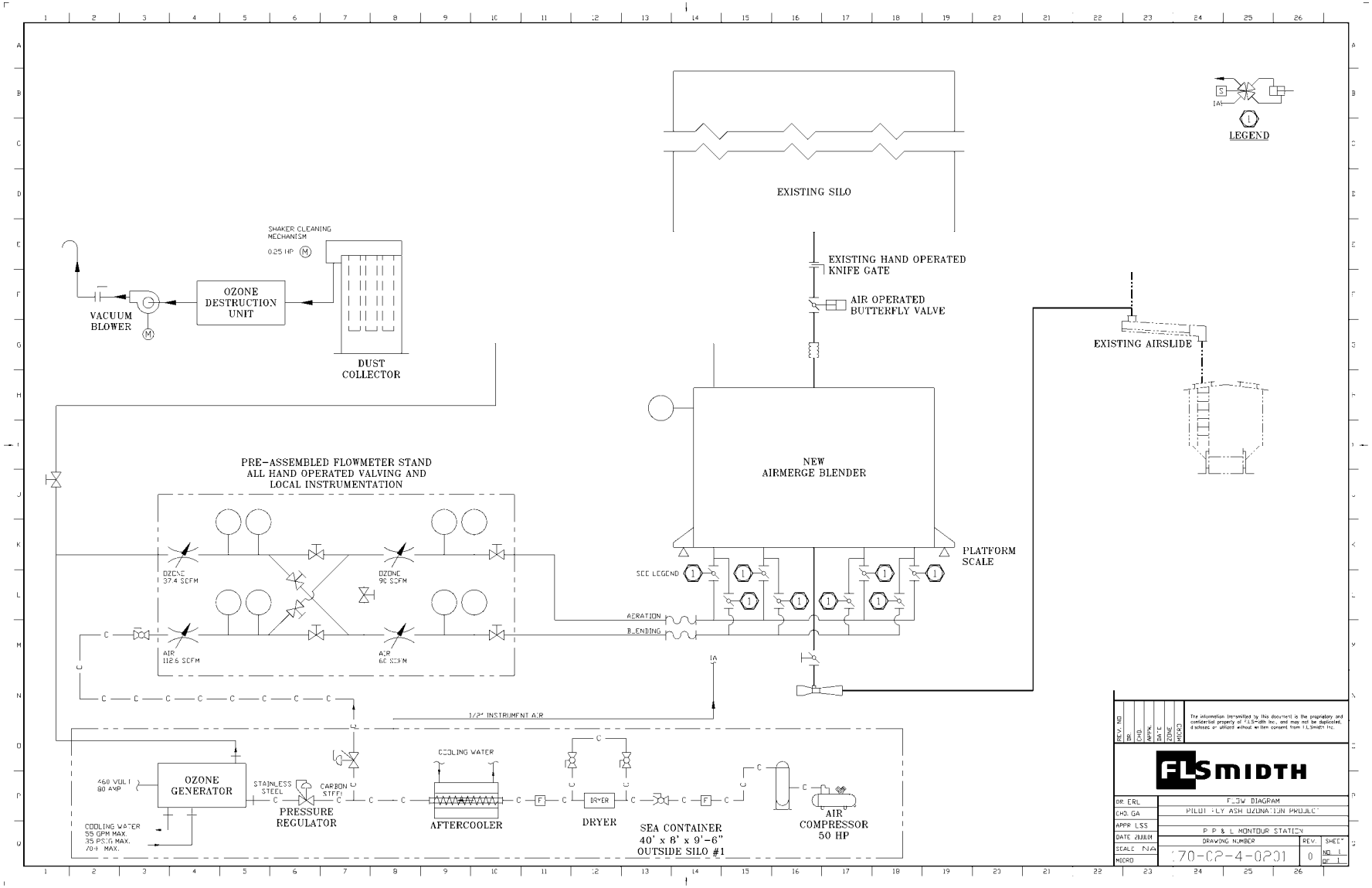


Figure 1 - Task 1 Semi-commercial scale installation of fluidization/ozonation technology at Montour (revised)

RESULTS AND DISCUSSION

The project has progressed on schedule and without any significant issues of concern throughout this quarterly period (October – December). The project manager has monitored progress and performance through dedicated and thorough meetings/conferences calls with the principals of the project team on a scheduled monthly basis, as well as additional informal discussions as appropriate.

A revised schedule is presented in figure 2. This revision reflects the delay in the actual start date of the project, as well as the minor delays to date in shipping equipment to the site. Key near-term milestones include the planned installation of the system at Montour in January 2005 and the planned parametric testing in February/March 2005. Figure 3 present a flow chart depicting the logic for the initial parametric tests.

Key discussions/issues during this period are summarized below.

October conference

Conference call notes

- Three major issues discussed
    - Ozone generator delivery delay (2-4 weeks)
    - Use of union/non-union labor at Montour (Larry to investigate further)
    - Test matrix. Initial matrix proposed by R, Hurt will be refined to address total number of tests, budget constraints and ash sources. Ashes 5 and 6 may be reevaluated based on the new test matrix. Ash source for Activated Contaminated ash being debated. One option will be to get STI-treated ash (e.g. Brandon Shores). There was discussion of getting CBO-treated ash to better isolate the effects of AC. More on this later after we discuss further. Number of concrete strength tests to be finalized will next test matrix. Assuming “lab” space at Montour these will be faster and less costly. No need to do concrete test for non-performing FI ashes). Will review Rich’s proposed matrix and reply.

Schedule impact due to O3 generator delay may or may not impact test dates. It was suggested to wait for further feed back from Wedeco on actual schedule before pushing test schedule out to February.

November conference

Summary of 11/15/04 conference call

WEDECO

- O3 generator ~85% complete
- VOD complete
- Planning to test next week (w/o 11/22/04)
- Planning to ship late following week (w/o/ 11/29/04)
    - Will send packing lists to FLS prior to shipment

FLS

- Schedule OK
- Erection to begin in January – no site work earlier than 1/1/05 (addresses labor union issue)
- Installation complete first week in February
- Followed by star-up/shake down testing

TEST PROGRAM

- Start date – Mid February 2005
- Test matrix/schedule – draft prepared
- Dairyland Ash – plan to combine tests to include Class C-only ash (important project datapoint) and Class C/F blend (important for Dairyland)
- Four ashes and two optional (little likelihood of happening due to budget constraints)

- PPL to discuss with STI source for ash #3 (AC contaminated ash)
- PPL will have technician to support test activities
- FLS will collect samples throughout test
- Concrete tests determined after FI results
- Rui/Bob to get revised test matrix to team and request feedback by 11/22/04 (attached below)

December conference

December 13, 2004 conference notes

WEDECO

O3 generator complete and tested – shipping this week
VOD complete and tested – shipping this week
Start-up to be scheduled when site is ready

FLS

Schedule impact from shipping delay above, to have potential 2-week delay
Erection to begin mid January - no site work earlier than 1/1/05
Installation complete second/third week in February
Followed by start-up/shake down testing

TEST PROGRAM

Start date – Late February 2005 (consistent with a 2-week delay)
Updated Test matrix/schedule to be revised (Bob/Rui) per FLS proposed Flow Chart
Draft matrix to go out to Bob Patton (DOE) after Larry's approval

No changes regarding ash selection for tests from last call (see below)
Dairyland Ash - plan to combine tests to include Class C-only ash (important project datapoint) and Class C/F blend (important for Dairyland)
Five ashes and one optional (little likelihood of happening due to budget)
PPL to discuss with STI source for ash #3 (AC contaminated ash)
PPL will have technician to support test activities
FLS will collect samples throughout test
Concrete tests determined after FI results

SAFETY

Respirators will be the responsibility of anyone needing to be at the O3 generator. It is anticipated that only two individuals will be needed there. FLS has capability to accommodate two individuals through their "breeder box".

MISCELLANEOUS

Reference ash FI tests will be done to provide sufficient baseline conditions

Ability to "throttle" down O3 concentration independent of gas flow was discussed as it is important to discriminate between effects early on in the program. Not clear how that was accomplished. To be discussed with Wedeco.

January Conference Call

If interim call is necessary, Larry will notify by separate e-mail. Otherwise,

Monday, 1/10/05 - 10am

Test Program Matrix and Schedule

As proposed and described in the original proposal and these Quarterly reports, the test program is designed to fully address all the key parameters associated with the operation of the ozonation system, as well as evaluate and optimize its performance with respect to the resulting flyash quality. The planned tasks are described in the Quarterly report in the section titled "**EXPERIMENTAL**".

This brief section and the attached Excel file "Revised test matrix and schedule.xls" are intended to provide a more detailed and current overview of the test program, its schedule (Figure 2), sequence and logic.

The flow chart below (figure 3) provides a general approach for the first batch of tests intended to determine the impacts of the major operating parameters (fluidization, ozone levels, contact times, bed height, velocities). This will serve as a guideline to "move through" the initial parametric tests and ensure that we are thorough as well as efficient. It essentially shows the logic behind the first phase of test for ash #1.

The attached Excel file contains two sheets: 1) current program schedule (which is also included in the December Quarterly report); and 2) a test matrix highlighting the general number of tests for each ash source planned. This matrix is intended to be flexible and optimized as the test program yields new information.

Figure 2. Revised Schedule

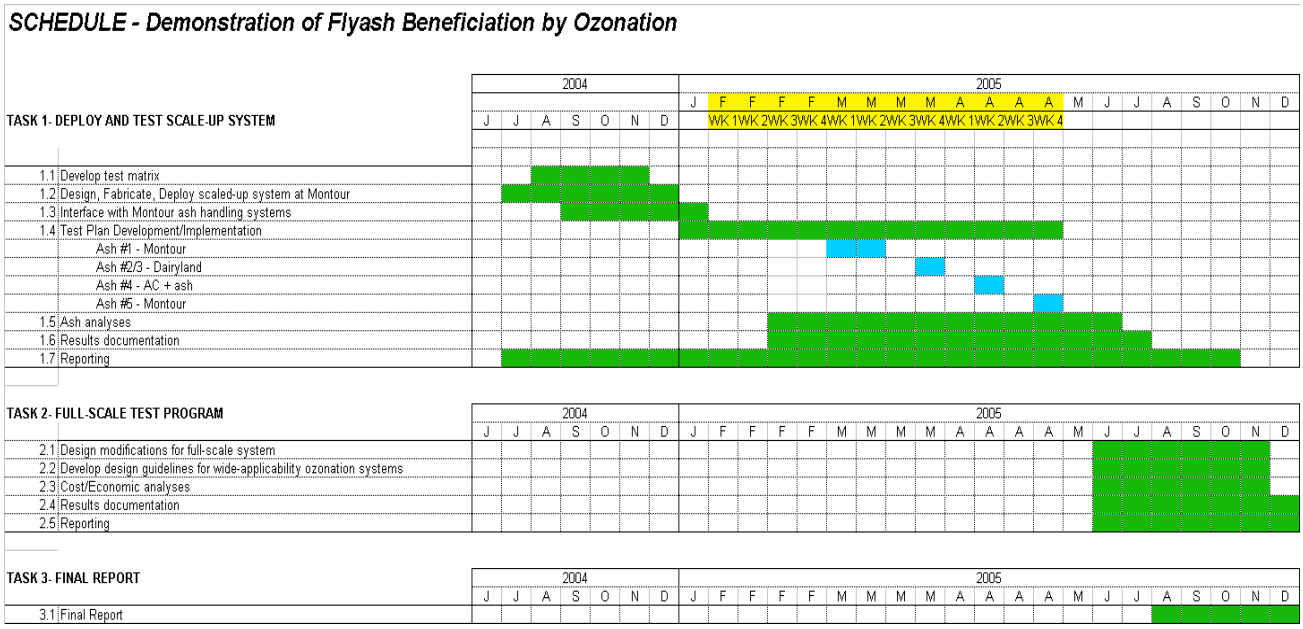
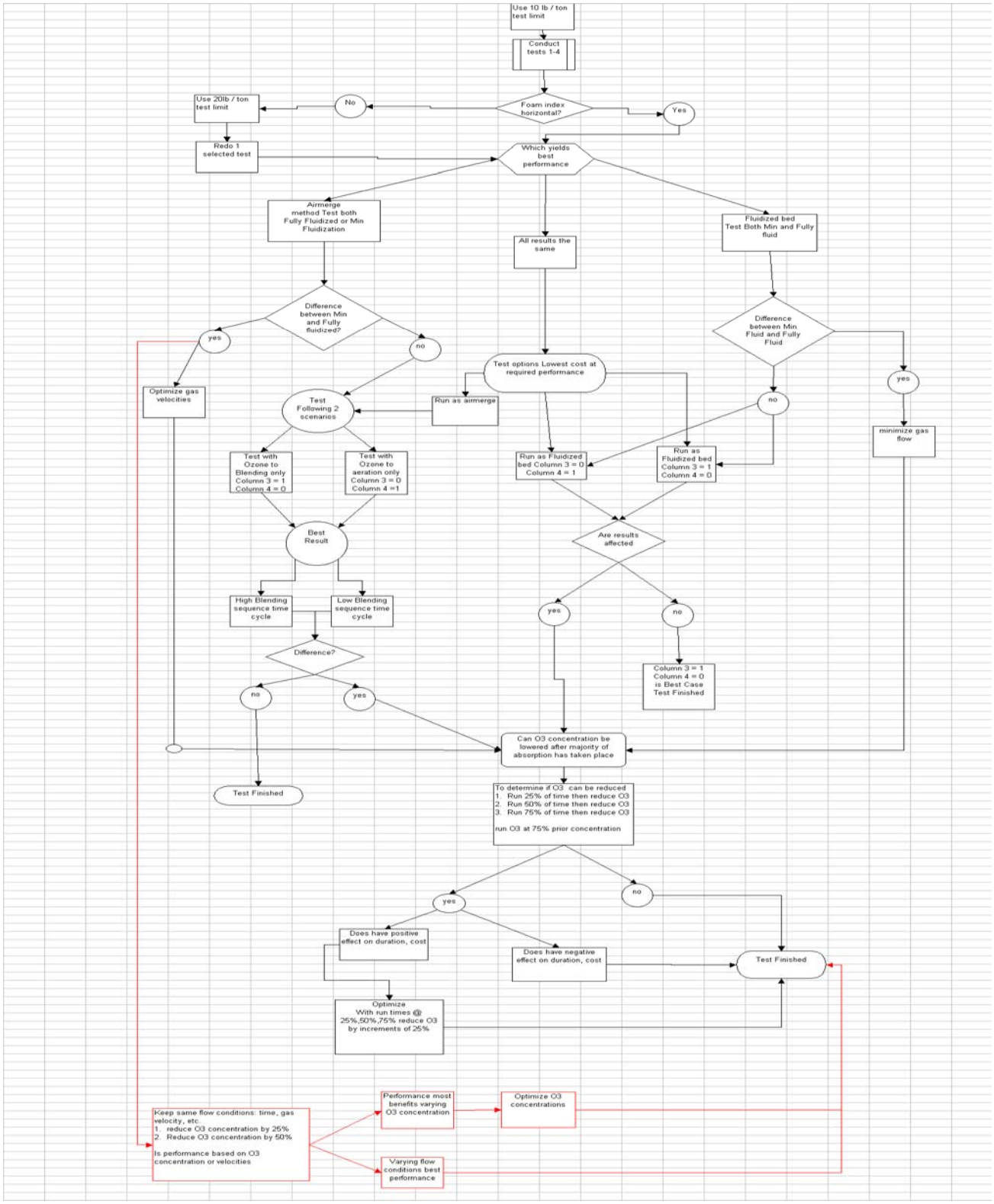


Figure 3. Initial Test Matrix Logic Flow Chart



CONCLUSIONS

No conclusions for this reporting period.

REFERENCES

None for this reporting period.

LIST OF ACRONYMS AND ABBREVIATIONS

DOE	Department of Energy
ESP	Electrostatic precipitator
FGD	Flue gas desulfurization
ID Fan	Induced draft fan
FI	Foam Index
cfm	Cubic feet per minute
kW	Kilowatt
MW	Megawatt
NETL	National Energy Technology Laboratory
O&M	Operating and Maintenance
PC	Pulverized coal
PRB	Powder River Basin
FBH	Fuller Bulk Handling Division
PPL	PPL Generation, LLC
EPRI	Electric Power Research Institute
EES	Energy and Environmental Strategies